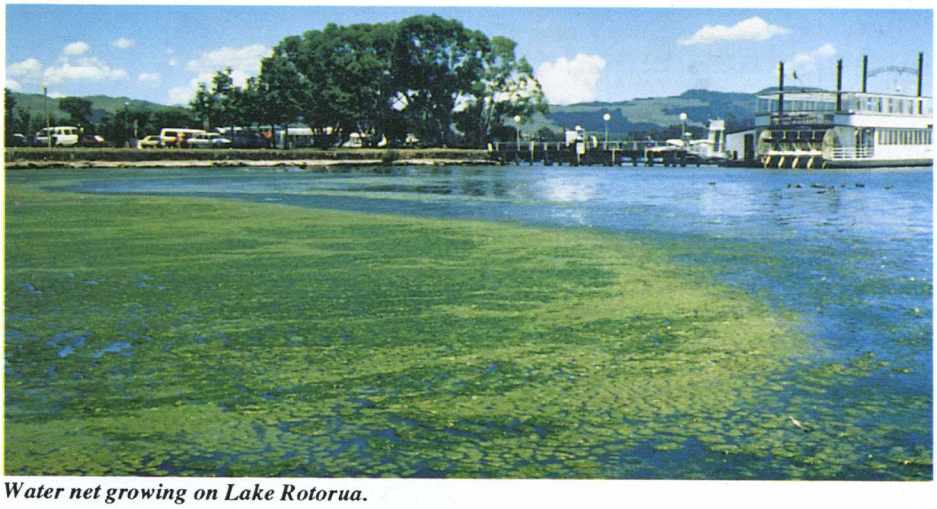

Water net growing on Lake Rotorua.

Restoration of degraded aquatic ecosystems

To understand how degraded aquatic ecosystems function so that methods can be developed to improve degraded environments and sustain their long-term use.

WE HUMANS are distressingly good at disrupting naturally-occurring ecosystems. Unfortunately, we are not nearly as successful at repairing the damage!

This NIWA research acknowledges that over the years, certain aquatic ecosystems in New Zealand have been seriously degraded. The aim is to develop cost-effective techniques to restore them. The programme concentrates on two increasingly common ecological problems for this country: turbid, phytoplankton-dominated lakes; and degraded, marine, intertidal shellfish beds. The research will contribute to the basic science of restoring degraded ecosystems. It will also include testing ecological principles in the design and use of managed, restored systems. This is new research for NIWA. It opens up a host of questions for investigation over the next 5-10 years. For example:

- How is biological community structure (e.g. genetic structure, composition or species diversity) linked with the functional aspects of ecosystems (e.g. productivity, nutrient cycling)?
- What are the separate and combined effects of abiotic (non-living) and biotic (living) factors in limiting the establishment and growth of recovering species in degraded systems?
- How do species' life histories and behaviours affect the population and community structure?
- How do abiotic factors and community-level interactions affect the productivity of populations of exploited species?
- What are the relationships between system complexity and stability?
- Does spatial heterogeneity influence the stability and resilience of ecosystems?
- Is there a minimum mix of species and life-forms that would assure the stability or persistence of a particular system?
- What mechanisms allow or prevent the coexistence of species?
- Under what conditions is restoration an ecologically defensible policy?
- Does the success of restoration techniques vary with the scale on which they are applied?

It is anticipated that both studies will culminate in at least one restoration exercise. At that stage, funding will be from both end-users and from the public good research budget. The "users" will benefit from the project itself, or from the techniques developed. The underlying research will be detailed scientific studies on ecosystems in transition and on ecosystem stability once a new state has been achieved.

Collaboration, both within New Zealand and overseas, underpins this research. For example, the results from NIWA's Lakes, and Coastal and Estuarine programmes provide much base data. Local agencies such as the Department of Conservation, MAF Fisheries and regional Fish and Game Councils, will provide local advice. Finally, both New Zealand and USA universities have confirmed joint research efforts. The programme forms part of New Zealand's contribution to the International Sustainable Biosphere Initiative (ISBI), the major focus of which is: "understanding the underlying ecological processes in natural and human-dominated ecosystems as a means towards restoration and management strategies which improve the sustainable use of Earth's ecological systems".

Programme coordinator: Rick Pridmore, NIWA Ecosystems

Improved treatment of dairy-shed wastewaters

To understand the long-term functioning of constructed wetlands treating dairy shed wastewaters in order to facilitate development of cost-effective treatment systems and enable dairy farmers to meet discharge standards that minimise environmental impacts and provide for sustainable management of receiving waters.

WHAT CAN New Zealand's dairy farmers do with a total of 125 million litres of wastewater per day, during the main dairy season? Since the 1970s, two-stage oxidation ponds have become the most popular disposal system. Although they are economical, both to install and to operate, surveys have shown that their discharges vary considerably in quality. In some cases, there is a real risk that oxidation pond discharges could be seriously polluting the waterways which receive them.

This programme continues investigations into one method of upgrading oxidation pond discharges: the use of constructed wetlands as a supplementary treatment.

Measuring physiochemical conditions in the root zone of wetland microcosms.

The results of initial research were outlined in *Water & Atmosphere* 1(2):5-6, showing that constructed wetlands are capable of significantly improving the quality of effluents from dairy shed oxidation ponds. Present research into constructed wetlands concentrates on determining the sustainability of treatment processes, and predicting the operational life of wetland treatment systems. This will lead to economic appraisal and the development of design guidelines for constructed wetlands.

Programme coordinator: Chris Tanner, NIWA Ecosystems